



# e-SBR

Emulsion  
Styrene-Butadiene Rubber

Proprietary  
process technology



polimeri europa



# POLIMERI EUROPA FOR PRODUCTION TECHNOLOGIES LICENSING

## Licensing

### Proprietary process technologies

#### Phenol and derivatives

PBE-1 Zeolite catalyst based Cumene \*  
Phenol, Acetone, Alkylphenols \*  
Isopropyl Alcohol Acetone hydrogenation \*  
Isopropyl Alcohol to Cumene \*

PBE-1 Zeolite catalyst

TS-1 Titanium silicalite catalyst based Ammoxidation

#### DMC and derivatives

Dimethylcarbonate  
via Carbon Monoxide and Methanol \*  
Dimethylcarbonate / Diphenylcarbonate \*

#### Polyethylene

LDPE  
HDPE  
EVA

#### Styrenics

PBE-1 and PBE-2 Zeolite catalyst based Ethylbenzene  
Styrene monomer  
GPPS  
HIPS  
EPS  
ABS continuous mass polymerization  
SAN

#### Elastomers

e-SBR  
s-SBR  
SBS / SB / LCBR  
Polybutadiene

### Proprietary catalyst technologies

Titanium silicalite  
PBE-1 Zeolite  
PBE-2 Zeolite

\* Co-licensing in cooperation with Lummus Technology

### Polimeri Europa

Polimeri Europa – the petrochemical company of Eni – manages the production and marketing of Basic Chemicals, Polyethylene, Elastomers and Styrenics.

With its 17 production sites throughout Europe and a widespread sales network, Polimeri Europa can present itself to the intermediates, thermoplastic resins and elastomers market as a sound and comprehensive supplier whose key strength is its integration. From raw materials to production plants, from research laboratories to technology, through to the interface with the market which can turn to a single source with the certainty of finding solutions to its requirements not only in terms of products, but also in terms of assistance and service. Thanks to the definition of the e-commerce and the logistic portal express, Polimeri Europa can offer to its customers the opportunity to use their tailored made e-shopping and logistics. Saving time and money.

On the basis of its first hand experience, Polimeri Europa can also license its proprietary production technologies aiming to satisfy the even more specific customers needs.

Polimeri Europa's commitment to quality, improvement and innovation continues, as does its pledge to promote sustainable growth with regard to the community and the environment.



## NOW AVAILABLE

### **Introduction to Polimeri Europa Emulsion SBR technology**

Emulsion polymerized styrene-butadiene rubber is one of the most worldwide used polymers, employed in a large variety of applications which significantly contribute to our standards of living as well as in enhancing our quality of life.

The unusually wide range of products achievable by the Polimeri Europa proprietary technology covers all e-SBR field of application like tires, footwear, light coloured mechanical goods, flooring, adhesives, pharmaceutical and food contact articles, microcellular articles, hoses, conveyor belts, high hardness soles and sheeting, technical goods with high hardness.

High Solids SBR Latices, whose main applications are in moulded foam, gel and non-gel carpet foam and stiffness enhancer Latices, are also leading product based on Polimeri Europa proprietary technology.

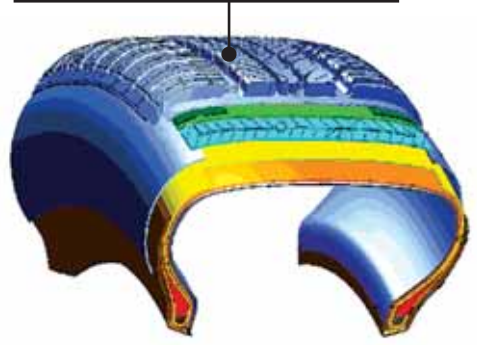
### **Basics of Emulsion SBR polymerization**

Styrene and Butadiene monomers polymerize in the presence of an emulsifier (fatty or rosin acid soaps), an initiator system, a modifier (mercaptan) and water. Initiator agent in case of cold polymerization is the redox reaction between chelated iron/organic peroxide and sodium formaldehyde sulfoxilate as reducing agent. The molecular weight distribution is primarily controlled by addition of mercaptan which terminates the growing chains beside initiating the new ones. Polymerization takes then place at the mild conditions typical of emulsion polymerization, controlling at the same time the reactants flowrate up to the addition of the shortstop agent – when desired conversion is reached – which rapidly reacts with free radicals blocking reaction. Residual butadiene and styrene are then removed from the shortstopped latices which is first stabilized by addition of appropriate antioxidant agents and then coagulated by using an inorganic acid and chemical aids to regulate the crumb dimensions. The coagulated crumb is then washed, dewatered, dried, baled and packaged.

# TECHNICAL DATA

## TREAD (NR/BR/SBR)

Ease of extrusion, Abrasion resistance,  
Low rolling resistance, Skid resistance



## Material balance and process economics

Per MT of Oil Extended Europrene® SBR 1712

Butadiene<sup>(1)</sup> + Styrene + Aromatic oil

Electricity<sup>(2)</sup>

Low pressure steam<sup>(2)</sup>

Cooling chilled water (delta T + 8 °C)

Per MT of Dry Europrene® SBR 1502

Butadiene<sup>(1)</sup> + Styrene

Electricity

Low pressure steam

Cooling chilled water (delta T + 8 °C)

<sup>(1)</sup> Reject butadiene recovery included. <sup>(2)</sup> Expected consumption

## Expected properties

### Oil Extended Types

Grades	Bound styrene % ASTM D5775
<b>Europrene® / Intol® 1712</b>	23.5

**Europrene® / Intol® 1778** 23.5

### Dry Types

Grades	Bound styrene % ASTM D5775
<b>Europrene® / Intol® 1500</b>	23.5

**Europrene® / Intol® 1502** 23.5

**Europrene® / Intol® 1509** 23.5

## Industrial applications

Polimeri Europa is one of the major industrial producer of Emulsion SBR with two industrial units, in Italy and UK. The Italian plant is on stream since 1957 based on a 120 kt/y capacity of Europrene® while the one in UK reaches a 75 kt/y capacity of Intol®.

SBR latices, low – and high solids, have been producing in Italy based on a 25 kt/y capacity, of Europrene Lattice® and in U.K. based on a 40 kt/y capacity of Intex®, both on a dry basis. HSR (High Styrene Resins) are also produced in Italy as Europrene HS®.

## The Europrene® e-SBR random copolymers properties and portfolio

Emulsion SBR is available in a range of Mooney viscosities, with 1500 series displaying some properties like easier incorporation of fillers and oil, less heat generation during mixing, higher extrusion rates and extrudate superior appearance while 1700 series have better green strength and higher acceptance of filler and oil loadings.

Increase in molecular weight strengthens the vulcanizate resilience and mechanical properties while SBR processability improves when molecular weight distribution broadens.

Processability is also affected by polymerization temperature leading to less chain branching at low temperature compared to the high temperature.

The emulsifier system also affects rubber properties as polymer emulsified with 100% Rosin acid gives better extrusion rates, slower cure rates and higher tack of the green compound while the use of 100% Fatty acid gives faster curing and high tensile properties.

The emulsifier system is then usually a blend of Fatty and Rosin acid.

950 kg
430 kWh
2,400 kg
290 m <sup>3</sup>
930 kg
470 kWh
3,000 kg
350 m <sup>3</sup>

related to reaction, monomer recovery and finishing sections only.

Mooney viscosity ML (1+4) 100°C ASTM D1646	Oil		Emulsifier	Coagulant	Stabilizer	Main applications
	Type	p.h.r. ASTM D5774				
51	Highly Aromatic	37.5	Fatty-rosin acid	Acid + chemical aids	Non staining	Tyres, retreading, conveyor belts, hoses, mechanical goods
49	Naphthenic	37.5	Fatty-rosin acid	Acid + chemical aids	Non staining	Footwear, flooring, microcellular articles, hoses, light coloured goods

Mooney viscosity ML (1+4) 100°C ASTM D1646	Emulsifier	Coagulant	Stabilizer	Main applications
52	Rosin acid	Acid + chemical aids	Non staining	Tyres, retreading, conveyor belts, hoses, mechanical goods
52	Fatty-rosin acid	Acid + chemical aids	Non staining	Tyres, footwear, sheeting, light coloured mechanical goods, flooring, adhesives, pharmaceutical and food contact articles
33	Fatty-rosin acid	Acid + chemical aids	Non staining	Footwear, microcellular soles, injection moulding, carpet underlay, extruded and calendered goods

# Process description

The Polimeri Europa e-SBR technology is based on a continuous polymerization reaction carried out through a series of reactors up to the desired reactants conversion is reached. Butadiene and Styrene monomers and demi water are first emulsified and pre-cooled, then solutions of catalyst, modifier and activator are added to the mixture before entering the first reactor. Each reactor is equipped with evaporating ammonia cooling coils allowing the selection of polymerization temperature according to the desired product grade.

Reaction is stopped in the last working reactor by shortstopper addition (catalyst & chemicals used are all available in the open market).

The emulsion is then discharged into lattice blow down drums and unreacted Butadiene is recovered through a two steps flash – the first one at atmospheric pressure and the next one under vacuum – submitted to compression and condensation and then recycled to the monomer storage section. Lattice is first pumped to the styrene stripping tower – where unreacted styrene is recovered by direct injection of L.P. steam – recovered as bottom product and then pumped to finishing section. OVHD vapours are condensed and sent to the water/styrene decanter. Styrene is first cooled and then recycled to recycle styrene tanks.

The uncondensed vapours containing mainly butadiene are sent to liquid ring vacuum pumps to be recovered while water from decanter is fully recycled to reaction, greatly reducing the environmental impact of the process.

Storage and blending tanks for Lattice display sufficient hold up to allow stopping the finishing section when product grade changes.

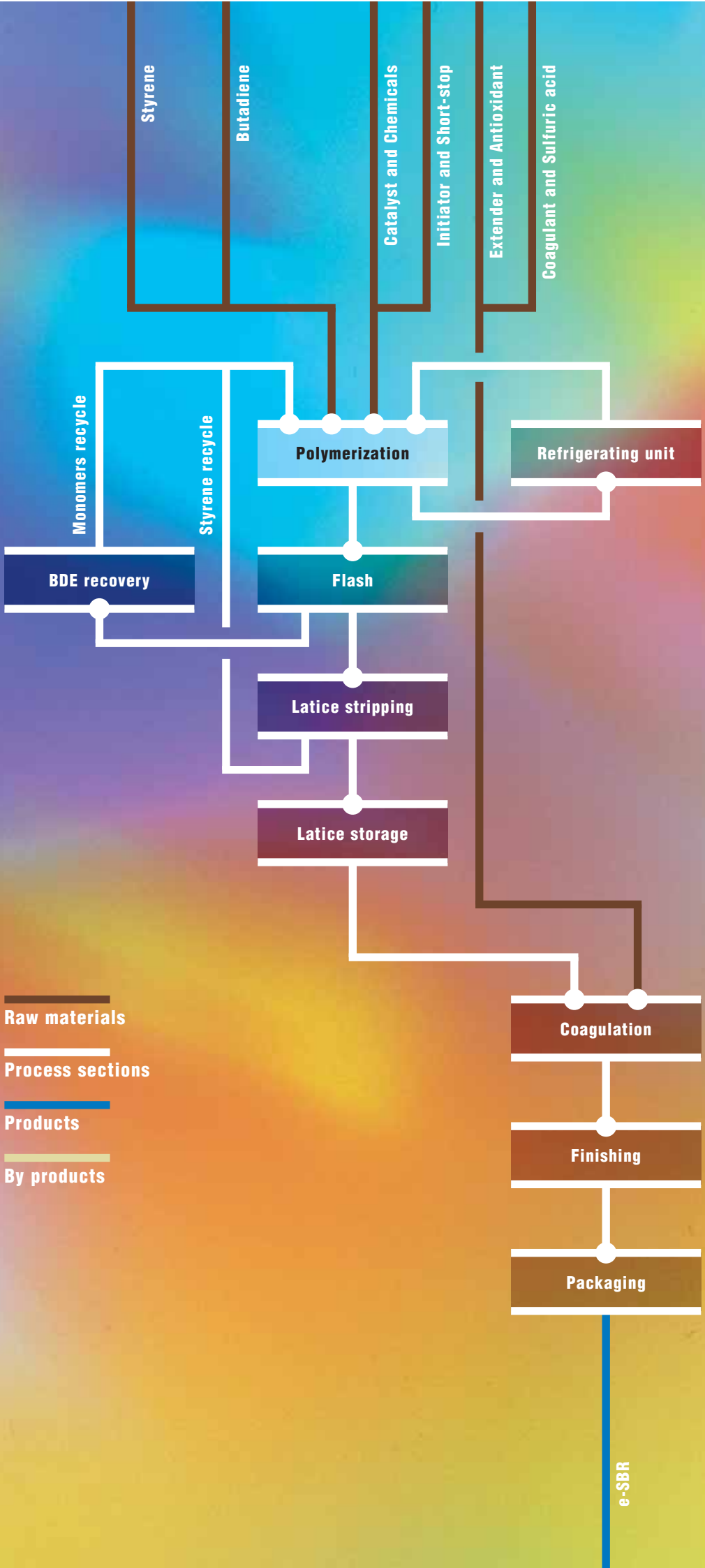
Finishing section is then fed by Lattice, antioxidant and extended oil (in case) which coagulate in a series of stirred vessels with a vibrating screen which separates rubber crumbs from water, sending them to the washing tank and then to the dewatering unit. Water content in SBR is reduced by means of a continuous hot air belt dryer (Apron dryer) and air is recycled by means of air blowers. The rubber is then fed to the balers, passes through a metal detector and finally the bales are wrapped by a PE film.

It is worth to note that a secondary ammonia service can be added to the plant to produce chilled water for the plant cooling devices.

## Process design advanced features

- High polymerization conversion reduces monomers and utilities consumptions leading to both high productivity and process capability.
- Lower dimensions of recovery section leads to lower capital investment.
- Rejected monomer quantity is reduced thanks to a specific section design, integrated with upstream plants, allowing reduction of slop quantity. Polimeri Europa is able to design this recovery section based on both client needs as well as site conditions. Possible technical options are the recycle to butadiene extraction unit, new recovery/distillation section or LP steam generation.
- The wide range of products grades coupled with a real process know-how enables meeting the specific needs of the customer.
- High capacity and flexibility allow production, in the same continuous reactors train, of base Latices blendable with batch or semibatch latices to produce a HSR/HSL grades <sup>(1)</sup> and SBR latices.
- All the environmental issues coming from gaseous effluents, liquid effluents, water consumption and solids effluents have been deeply considered in the design base of each process stage, according to the best available technologies as well as to the IISRP suggestions to the E.U. Authorities. Significant examples are given below:
  - Water recycle** All the watery phase recovered after the Lattice stripping are recycled to reaction, no water streams from reaction or monomer recovery to CWWT.
  - VOC captation** Vapour streams from reaction and recovery areas are connected to flare system also for maintenance operations (low emission factors).
- High valuable technical assistance is given to the customer by Polimeri Europa R&D structure, whose long experience and know how on small, medium and large size pilot plants really supports new e-SBR Producer entering the market.

(1) Polimeri Europa can offer Hot Latices technology (batch or semibatch) whose products are blendable with e-SBR Latices giving High Solids Latices (HSL) and High Styrene Resins (HSR) materials with increased styrene content.



- Raw materials
- Process sections
- Products
- By products

e-SBR

# Polimeri Europa SpA

A subsidiary of Eni SpA  
Sole shareholder company

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Responsible Care



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